NON-PUBLIC?: N
ACCESSION #: 8902240022
LICENSEE EVENT REPORT (LER)

FACILITY NAME: McGuire Nuclear Station, Unit 1 PAGE: 1 OF 9

DOCKET NUMBER: 05000369

TITLE: Spurious Train A Safety Injection and Main Steam Isolation Resulting in a Reactor Trip Due to Unknown Causes
EVENT DATE: 03/23/88 LER #: 88-005-01 REPORT DATE: 02/15/89

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE TO NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On 03/23/88 at approximately 1051, Instrumentation and Electrical (IAE) personnel, while performing a monthly functional test, closed the Unit 1 Solid State Protection System (SSPS) Train A logic cabinet door and instantly heard a relay energize. Operations (OPS) was immediately alerted to a Turbine Trip/Reactor Trip annunciator and indication of Control Rod insertion. Among the numerous alarms and indications, a Safety Injection (SI) actuation and a Main Feedwater (CF) system isolation had occurred. The CF isolation tripped CF Pumps 1A and 1B due to high discharge pressure, which led to the Unit 1 Turbine Trip/Reactor Trip. Also, a Unit 1 Main-Steam (SM) system isolation occurred, but with no supporting isolation signals present. OPS implemented Reactor Trip, Safety Injection, and Notification Of Unusual Event procedures. The Train A SI and SM isolation signals were reset. Unit 1 was stabilized near no load conditions at approximately 1120 on 03/23/88. This event was assigned a cause of Other since the cause of the Unit 1 Train A SI and SM isolation signals could not be determined. IAE will inspect the SSPS Train A logic cabinet more closely during an upcoming outage. This event will be reviewed during Segment 4 of Licensed Operators Requalification Training.

END OF ABSTRACT

INTRODUCTION:

On March 23, 1988 at approximately 1051, Instrumentation and Electrical (IAE) personnel, while performing a monthly surveillance functional test, closed the Unit 1 Solid State Protection System (SSPS) Train A logic cabinet door and instantly heard a relay energize. Operations (OPS) personnel were immediately alerted to a Turbine EIIS:TRB! Trip/Reactor EIIS:RCT! Trip annunciator EIIS:ANN! and indication of Control Rods falling into the Reactor Core. Among the numerous alarms and indications, OPS personnel recognized a Safety Injection (SI) EIIS:BQ! actuation had occurred and immediately determined it was a Unit 1 SI from Train A by a scan of the SI automatic actuation items, one of these being a Main Feedwater (CF) system EIIS:SJ! isolation. The CF isolation tripped CF Pumps 1A and 1B EIIS:P! because of high discharge pressure, which led to the Unit 1 Turbine Trip/Reactor Trip. OPS personnel also recognized a Unit 1 Main Steam (SM) system EIIS:SB! isolation had occurred, but with no supporting isolation signals present. OPS personnel implemented procedures AP/1/A5500/01, Reactor Trip, EP/1/A/5000/01, Safety Injection, and RP/0/A/5700/01, Notification Of Unusual Event. The Train A SI and SM isolation signals were reset. Unit 1 was stabilized near no load conditions at approximately 1120 on March 23, 1988.

Unit 1 was in Mode 1, Power Operation, at 100% power at the time of this event.

This event was assigned a cause of Other since the cause of the Unit 1 Train A SI and SM isolation signals could not be determined.

EVALUATION:

Background

The SSPS EIIS:JC! is capable of supplying both Reactor and component trip signals and initiating Engineered Safeguard Features (ESF) EIIS:JE!. Two redundant trains provide equipment protection during normal operating and casualty conditions. By the use of several different test switches located in the SSPS logic cabinet, it is possible to determine that every logic decision is made correctly and thus verify the SSPS will properly respond to generated signals and initiate a Reactor Trip or an ESF Actuation. During testing, all output signals from the train in the test mode are blocked and no automatic or manual ESF Actuation can occur. Multiplexing techniques are employed to transmit status information to the control board and the Operator Aid Computer

EIIS:CPU!. With a given combination of input signals indicating unsafe operating conditions, the SSPS will not only inform OPS personnel but will also automatically shutdown the Reactor and/or cause the necessary ESF Actuations. The solid state logic operates master relays EIIS:RLY! which in turn operate slave relays. These slave relays are used for contact multiplication, which apply power to plant process equipment such as pumps, solenoid EIIS:SOL! valves EIIS:V!, drive motors EIIS:MO!, and relay coils EIIS:CL!.

The Safety Injection (NI) system EIIS:BQ! is designed to provide Emergency Core Cooling to prevent fuel clad melting, assuring the core will stay in place and largely intact, in case of a Loss Of Coolant Accident (LOCA) or steamline break accident. The system is composed of two redundant trains which are physically and electrically separate and operate independently of each other. It is designed to tolerate a single failure without loss of its core protective functions. The SSPS generates an SI signal when one of the following events occurs:

A. Low steam line pressure;
B. Low Pressurizer pressure;
C. High Containment pressure; or,
D. Manual actuation.

This SI signal in turn actuates the following items:

A. The cold leg accumulator injection isolation valves which are opened for injection of borated water into the cold legs of the Reactor Coolant (NC) system EIIS:AB!;

NOTE: These valves are normally left open with power removed according to Technical Specification (TS) 3/4.5.1.1.

B. Chemical Volume and Control system EIIS:CB! pumps, NI pumps, Residual Heat Removal system EIIS:BP! pumps and associated valves which provide emergency makeup water to the cold leg of the NC system following a LOCA;

C. Nuclear Service Water (RN) system EIIS:BI! pumps which provide cooling water to the Component Cooling system EIIS:CC! heat exchangers, EIIS:HX! which are heat sinks for containment EIIS:NH! cooling;

D. Motor driven CA pumps that provide feedwater to all available Steam Generators (S/Gs) EIIS:SG! which become a heat sink for the NC

system; and,

E. Emergency Diesel Generators (D/Gs) EIIS:DG! to assure backup supply of power to emergency and supporting systems components.

Description of Event

On March 23, 1988, at approximately 0930, IAE personnel were performing Unit 1, monthly surveillance functional testing of Source Range Neutron Flux Channels N31 and N32 EIIS:DET!. Testing on Channel N31 had been completed during the preceding hour, and at 1037, OPS personnel declared Channel N32 inoperable, which was logged in the Unit 1 Technical Specification Action Item Logbook (TSAIL). Procedural testing then commenced. At approximately 1051, IAE Technician A placed the SSPS Train A Multiplex Test Switch in the "A + B" position in accordance with surveillance procedure PT/O/A/4600/14C, Nuclear Instrumentation System Source

Range Functional Test, step 12.5. IAE Technician B performed Independent Verification of this step and as Technician A closed the logic cabinet EIIS:CAB! left door, the rotating latch mechanism lightly bumped against the stationary latch catch plate on the center post of the cabinet frame. Immediately following the bump, Technician A heard the sound of a relay energizing in the right side of the cabinet. He then heard the sound of several SSPS logic cabinet relays energizing along with numerous annunciator alarms and bells from the Unit 1 Main Control Board EIIS:MCBD! area.

At 1051:54.394, an SM isolation signal and indication of a Unit 1 Train A SI, which caused a CF isolation, were received. D/G 1A started and the CF isolation tripped CF Pumps 1A and 1B on high pump discharge pressure. The loss of both CF pumps caused a Turbine Trip, which initiated the Reactor Trip. OPS personnel then manually initiated a Reactor Trip to ensure the Reactor Trip Breakers had opened. OPS personnel also immediately determined the SI had initiated from Train A by a scan of the SI automatic actuation items. Because of the loss of both CF Pumps, CA Pump 1B started immediately, and CA Pump 1A started as the D/G Load Sequencer made power available. At 1052:11, the S/G Code Safety Relief Valves opened to relieve SM system pressure and to provide a heat sink for the NC system through all four S/Gs. At approximately 1052, OPS personnel declared an Unusual Event and notified the appropriate authorities as directed by procedure RP/O/A/5700/01, Notification of Unusual Event. After approximately one minute, the S/G Code Safety Relief Valves EIIS:RV! started to close. At approximately 1100, OPS personnel reset the SI and the SM isolation signals. At approximately 1103, all four S/G Power Operated Relief Valves (PORVs) EIIS:RV! started to cycle open and closed to relieve SM system pressure. At approximately 1120, OPS personnel stabilized

Unit 1 near no load conditions with the exception of a high Pressurizer (PZR) EIIS:PZR! level, because of the introduction of SI water into the NC system.

At approximately 1125, IAE personnel were discussing with the Westinghouse Site Electrical Representative the possibility that bumping the Unit 1 SSPS Train A cabinet door actually caused the Train A SI and SM isolation. An IAE staff engineer lightly bumped the center post of the cabinet two or three times with the heel of his hand, and instantly relays were heard energizing and de-energizing in rhythmic succession within the cabinet. Immediately following this, at 1126:15, OPS personnel reported that an SM isolation was again initiated causing all four SM isolation bypass control valves EIIS:ISV! to close, and asked the IAE personnel what may have caused the condition. IAE and OPS personnel concluded that bumping the cabinet caused the Train A SI and SM isolation signals. After studying the Unit 1 Transient Data and SSPS logic drawings, IAE personnel began looking for probable fault locations.

At approximately 1340, IAE personnel were able to get the fault to repeat twice more by bumping the cabinet, but could not electrically isolate the cause. IAE personnel then attempted, without results, to get the fault to repeat by physically manipulating and vibrating individual components such as relays, printed circuit cards, bus work, switches, solder connections, wire bundles,

and wire terminations. A careful visual inspection was performed using a magnifying glass to verify the presence of any physical wiring problems or debris, but none were found. At approximately 1615, IAE personnel performed the monthly surveillance test on the SSPS Train A cabinet to verify its operability. At approximately 1730, IAE cleaned the cabinet with approximately 50 psig compressed air to attempt to remove any foreign debris. The doors to the cabinet were then closed for about three hours to determine if the fault was heat related; however, no fault occurred.

At approximately 0100 on March 24, 1988, a technical review group consisting of IAE Staff and Management personnel, the Westinghouse Site Electrical Representative, Operations Management personnel, Integrated Scheduling personnel, and the Station Manager met to evaluate the situation. After reviewing the findings, the group determined the most likely cause of the fault was a wire fragment or piece of debris which fell across and shorted or grounded an undetermined point (or points) in the cabinet circuitry causing the spurious Train A SI and SM isolation signals. The group also speculated that subsequent bumping and jarring of the cabinet caused the debris to fall clear; therefore, the fault was not reproducible. IAE personnel initiated a work request to physically inspect the SSPS Train A logic cabinet more closely during a future Unit 1 refueling outage.

Unit 1 was returned to Power Operation on March 24, 1988 at 1109.

Conclusion

This event was assigned a cause of Other because of the spurious and unknown cause of the Unit 1 Train A SI and SM isolation signals. Extensive and thorough troubleshooting by IAE personnel did not uncover a specific cause, but did support the speculation that a wire fragment or piece of debris fell across and shorted or grounded an undetermined point (or points) in the SSPS Train A logic cabinet circuitry when the cabinet was bumped. The fact that IAE personnel were able to induce the signals several times and the subsequent complete disappearance of the fault also supports the theory. The Reactor Trip was caused by a Turbine Trip from a CF system isolation, which was caused by the Train A SI. Also, an SM system isolation signal was received. This sequence of isolation would not be a normal occurrence from the SSPS logic given the normality of all the other parameters monitored. Routine monthly surveillance functional testing will verify the operability and integrity of the cabinet, and a quarterly cabinet cleaning and housekeeping PM should minimize the possibility of a future similar event.

Several anomalies occurred during the recovery from the Reactor Trip. Valve lSV-16, SM 1B Safety No. 3, failed to open even though S/G 1B pressure indicated the setpoint was exceeded. A work request was initiated by OPS personnel to check the associated pressure switch for accuracy, which was subsequently found to be within current calibration tolerances. IAE personnel had previously identified the presence of a water leg from the condensation of steam in the pressure switch impulse lines. Projects personnel are now processing

exempt changes for Unit 1 and Unit 2 that will resolve the problem. Valve 1SV-13, S/G 1C PORV, did not indicate cycling open and closed while the other three S/G PORVs did. Performance personnel reviewed the Unit 1 Transient Data and verified that the valve actually did cycle; therefore, a work request was initiated by Performance personnel to correct the position indication failure. There was a noted disparity between the recorded time on the Unit 1 Events Recorder and Alarm Typer of approximately 2.5 seconds at the start of the event that increased to approximately 10 seconds later in the day. Performance personnel have initiated a work request to identify and correct the reason for the difference. Since only a Train A SI was received, and because of the design of the RN system, RN Pump 1B and 2B suction and discharge valves closed, isolating the operating pumps. Also, the Unit 2 nonessential header isolation valve closed causing a loss of RN system flow to the Unit 2 nonessential header. This header supplies cooling water for the

containment ventilation and NC pump motor coolers EIIS:CLR!. If not for quick analysis and proper realignment of RN system flow by OPS personnel, temperature limits for lower containment and the NC pump motor stators would have been exceeded, and Unit 2 would have been required to shut down. OPS personnel failed to recognize that RN Pump 1B was isolated. Flow was re-established through the pump by OPS personnel after approximately 16 minutes. To ensure the pump was operable, Performance personnel conducted a pump head curve test as directed by t
e RN Train 1B Performance Test procedure,
PT/1/A/4403/01B. The test was completed with satisfactory results and RN Pump 1B was returned to service.

A review of McGuire Licensee Event Reports (LER) revealed one previous event involving a Reactor Trip in which the root cause was unidentifiable; therefore, this event is considered recurring. However, the two events are not similar in any other respect; therefore, the corrective actions for LER 369/85-36 could not have prevented this event from occurring.

The Post-Reactor Trip Plant Response is classified as a Category B since all transient classification criteria fell within Category A (plant responses remained within preferred or expected bounds) with the exception of a high PZR level, because of the injection of SI water into the NC system.

OPS personnel responded in a timely and appropriate manner to bring Unit 1 to a stable condition.

This event is not reportable to the Nuclear Plant Reliability Data System (NPRDS).

CORRECTIVE ACTIONS:

Immediate: 1) OPS personnel implemented procedure AP/1/A/5500/01, Reactor Trip, for the Unit 1 Reactor Trip.

2) OPS personnel implemented procedure EP/1/A/5000/01, Safety Injection, for the Unit 1 SI.

3) OPS personnel implemented procedure RP/O/A/5700/01, Notification Of Unusual Event, for the Unusual Event.

4) OPS personnel stabilized Unit 1 near no load conditions by approximately 1120 on March 23, 1988.

Subsequent: IAE personnel performed troubleshooting and verified

operability of the Unit 1 SSPS Train A logic cabinet.

Planned: 1) IAE will physically inspect the SSPS Train A logic cabinet more closely according to Work Request 67973.

2) McGuire Operations Training personnel will ensure this event is reviewed during Segment 4 of the Licensed Operator Requalification Training.

3) A supplement to this report will be submitted to describe any conclusions reached by IAE personnel during the inspection described by corrective action no. 1.

SAFETY ANALYSIS:

The spurious Train A Safety Injection signal originated downstream of the Reactor Trip undervoltage relay, and therefore did not directly initiate a Reactor Trip. Rather, the SI signal directly initiated a CF isolation and Containment Phase A Isolation, which caused the CF pumps to trip on high discharge pressure. The loss of both CF pumps caused a Turbine Trip, which initiated the Reactor Trip.

The sequence of events associated with this event are bounded by the "Inadvertent Operation of Emergency Core Cooling System During Power Operation" event as described by the McGuire FSAR Chapter 15, Accident Analysis, which for this event covers the case of (1) when the initiating signal directly results in a Reactor Trip, and (2) when the initiating signal initiates a transient which leads to a Reactor Trip or is terminated by a manual Reactor Trip. In the actual event, the Reactor Trip was essentially immediate, although not a direct result of the SI signal. The conclusions made in the Accident Analysis are based on a transient which is terminated by an eventual Reactor Trip on low PZR pressure. Therefore, the actual transient was relatively conservative, placing the safety aspects of this event within the scope of the Accident Analysis.

At the time the spurious SI signal was generated, a simultaneous and spurious SM system Isolation signal also occurred. Plant equipment responded as designed to the various signals which occurred. The SI signal and all appropriate Train A load groups were energized. The Emergency Core Cooling System pumps started, with only a centrifugal charging pump actually injecting to the NC System, which lasted for approximately 10 minutes. Because of the trip of the CF pumps, the motor driven CA pumps started to remove residual heat through the S/G Code Safeties. The S/G PORVs and the steam dump system were initially unavailable because of the SM system Isolation.

The SI and SM system Isolation signals were reset approximately ten minutes after the initiating event. Prior to resetting the signals, the responses of key parameters were adequate with the exception of PZR level which was high and increasing because of the addition of SI flow. When the signals were reset, the PORVs on all four steam lines opened and began cycling as steam pressure was being stabilized. The effect of the steam pressure fluctuations was evident in the response of S/G level, NC system T-average, and PZR level and pressure.

It has been concluded that the spurious SI did not present any hazard to the integrity of the NC System and did not result in the release of fission products to the coolant.

There were no personnel injuries, personnel overexposures, or releases of radioactive material as a result of this event.

This event is considered to be of no significance with respect to the health and safety of the public.

Additional Information:

In response to Planned Corrective Action No. 1, Instrumentation and Electrical (IAE) personnel conducted a thorough inspection of the Train A SSPS Logic Cabinet during the 1988 Unit 1 Refueling Outage. Results of the inspection revealed a loose piece of solder on the logic test panel face plate. IAE personnel were unable to identify specifically where the solder piece was before it fell onto the face plate when the logic test panel was tilted forward to allow a close inspection of test switch wire terminations and wiring. IAE personnel found no other debris or items such as frayed wire insulation, wire whiskers or damaged wire terminations which could have caused the event.

IAE personnel believe the loose piece of solder may have been the cause of the spurious Train A Safety Injection and Main Steam system isolation signals. A survey of work history for SSPS Train A Logic Cabinet provided no clues as to the origin of the solder piece. There has been no modification or repair work within the logic cabinet that required the use of soldering equipment prior to the incident.

Between the occurrence of this event and the start of the 1988 Unit 1 Refueling Outage, monthly Preventive Maintenance surveillance functional testing of SSPS Train A had been successfully performed six times. Results of these tests revealed no problems or symptoms that could be connected to the occurrence of this event. Additionally, Response Time, Engineered Safeguard Features, and Nuclear Instrumentation testing was completed during the outage

but no discrepancies could be linked to the event.

IAE personnel feel confident that the cause of the spurious Train A Safety Injection and Main Steam system isolation signals has been removed or cleared from the SSPS Train A Logic Cabinet, and that this event is not likely to recur. The quarterly cabinet cleaning and housekeeping Preventive Maintenance activity should help minimize the possibility of a future similar event.

Duke Nuclear Safety Assurance personnel performed an additional review of this event in an attempt to help identify the cause of this event, but the conclusion reached was the same (unknown).

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February 15, 1989

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station, Unit 1
Docket No. 50-369
Licensee Event Report 369/88-05-01

Gentlemen:

Pursuant to 10CFR 50.73 Sections (a)(1) and (d), attached is revised Licensee Event Report 369/88-05-01 transmitting additional information regarding the results of a thorough inspection of the Train A SSPS Logic Cabinet during the Unit 1 1988 Refueling Outage. This report is being submitted in accordance with 10CFR 50.73(a)(2)(iv). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

SEL/389/sel

Attachment

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